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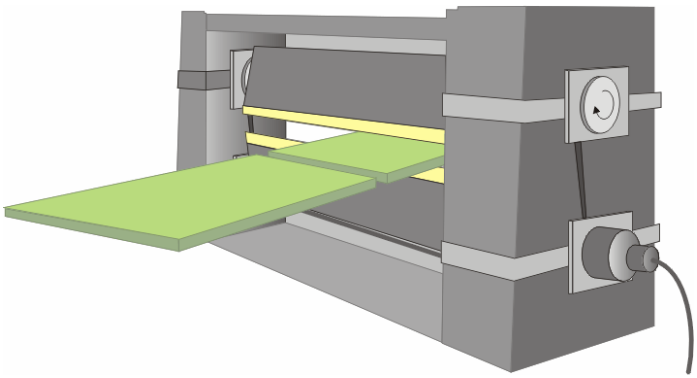
control – motion – interface

CT 701.04

Motion Control Firmware for Rotary "Guillotine" Shears with MC700 Controllers



- Easy parameter setting instead of sophisticated programming, immediately ready to work with minimum commissioning time
- Synchronous cutting process, with cosine-compensated motion profile during penetration of the cutting tool
- Particularly suitable for "flying cut" of steel plates, sheet metals and profiles
- High dynamic response by means of short cycle time
- High cutting precision due to
- 400 kHz of feed-back frequency
- Suitable for "stand-alone" operation as well as for connection to field bus systems (CANBUS, PROFIBUS etc.)

Operating Instructions

Safety Instructions

- This manual is an essential part of the unit and contains important hints about function, correct handling and commissioning. Non-observance can result in damage to the unit or the machine or even in injury to persons using the equipment!
- The unit must only be installed, connected and activated by a qualified electrician
- It is a must to observe all general and also all country-specific and application-specific safety standards
- When this unit is used with applications where failure or maloperation could cause damage to a machine or hazard to the operating staff, it is indispensable to meet effective precautions in order to avoid such consequences
- Regarding installation, wiring, environmental conditions, screening of cables and earthing, you must follow the general standards of industrial automation industry
- - Errors and omissions excepted –

Version:	Description:
CT701 04A/ TJ/ Feb. 2006	Outputs “Homing Done” and “Automatic Operation” added; Diagnosis output “Ana Out 1” added
CT701 04B/ TJ/ Aug. 2008	Motrona version

Table of Contents

1. Preamble: 4
2. General remarks about functions of this firmware 5
3. Download Procedure 7
4. How to use the operator software 9
   - 4.1. I/Os (Inputs and Outputs) 9
   - 4.2. General Parameters 12
   - 4.3. Parameter Blocks 13
     - 4.3.1. Circs/ Pulses 13
     - 4.3.2. Index Settings: 14
     - 4.3.3. Ramps 14
     - 4.3.4. Control Loop 14
     - 4.3.5. Jog/Home 15
     - 4.3.6. Alarms 15
     - 4.3.7. Diagnosis 15
     - 4.3.8. Communication settings: 15
     - 4.3.9. Setup Settings: 17
5. Function of the LED indicators 18
6. Steps for Commissioning 19
   - 6.1. Preparations 20
   - 6.2. Directions of Rotation 20
   - 6.3. Tuning the analogue output 21
   - 6.4. Setting of the proportional Gain 21
7. Process data (actual values) 22
8. Hints for controller type MC720 with integrated operator terminal 23
   - 8.1. Setting of parameters and registers 23
   - 8.2. Display of actual process values 23
9. Parameter Tables 25

1. Preamble

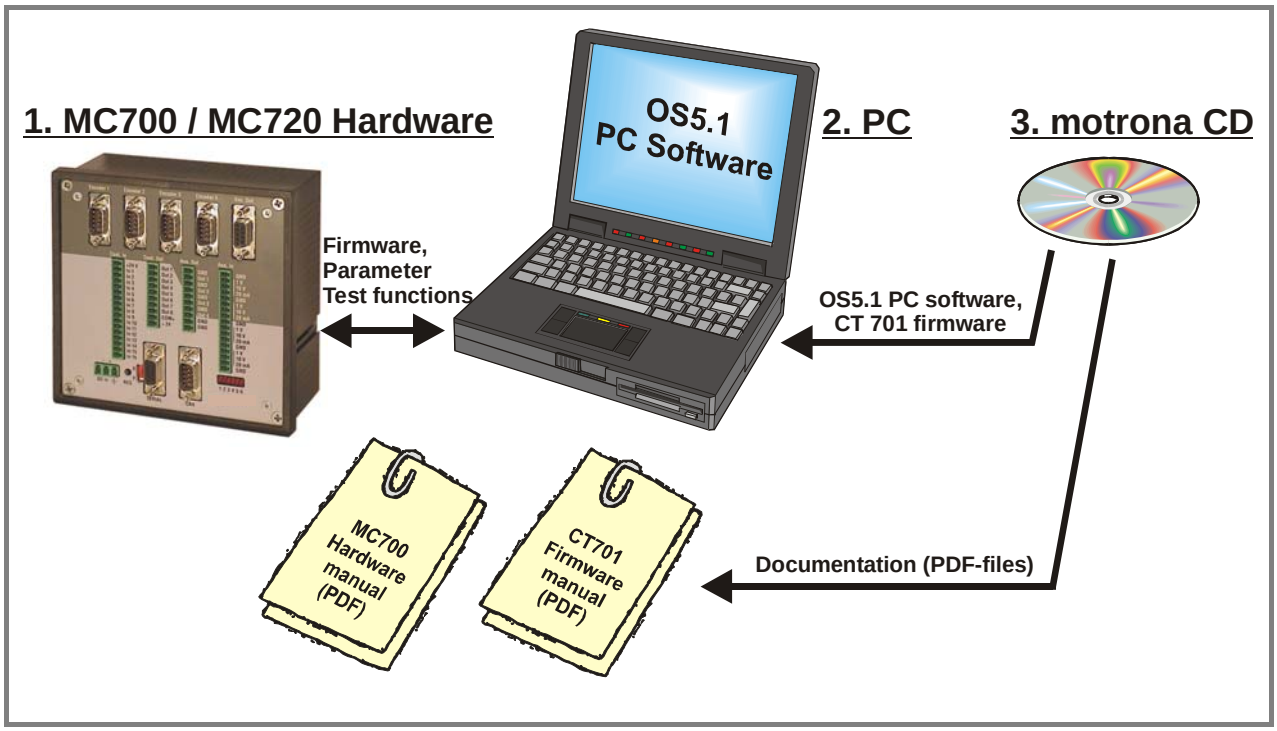
This document provides all information about the CT701 firmware, including parameters, variables and hints for commissioning.

To implement this application, you will need:

1) A motion controller hardware of type MC700 or MC720
2) A PC with operating system Windows 95, 98, NT, 2000 or XP
3) The motronaCD containing the PC operator software OS5.1, the firmware file CT701xxx and the pdf files for the manuals MC700xxx.pdf (hardware description, connections, specifications) and CT701xxx.pdf (description of the firmware as actually at hand)

All of above files are also available for free download from our homepage:

www.motrona.de

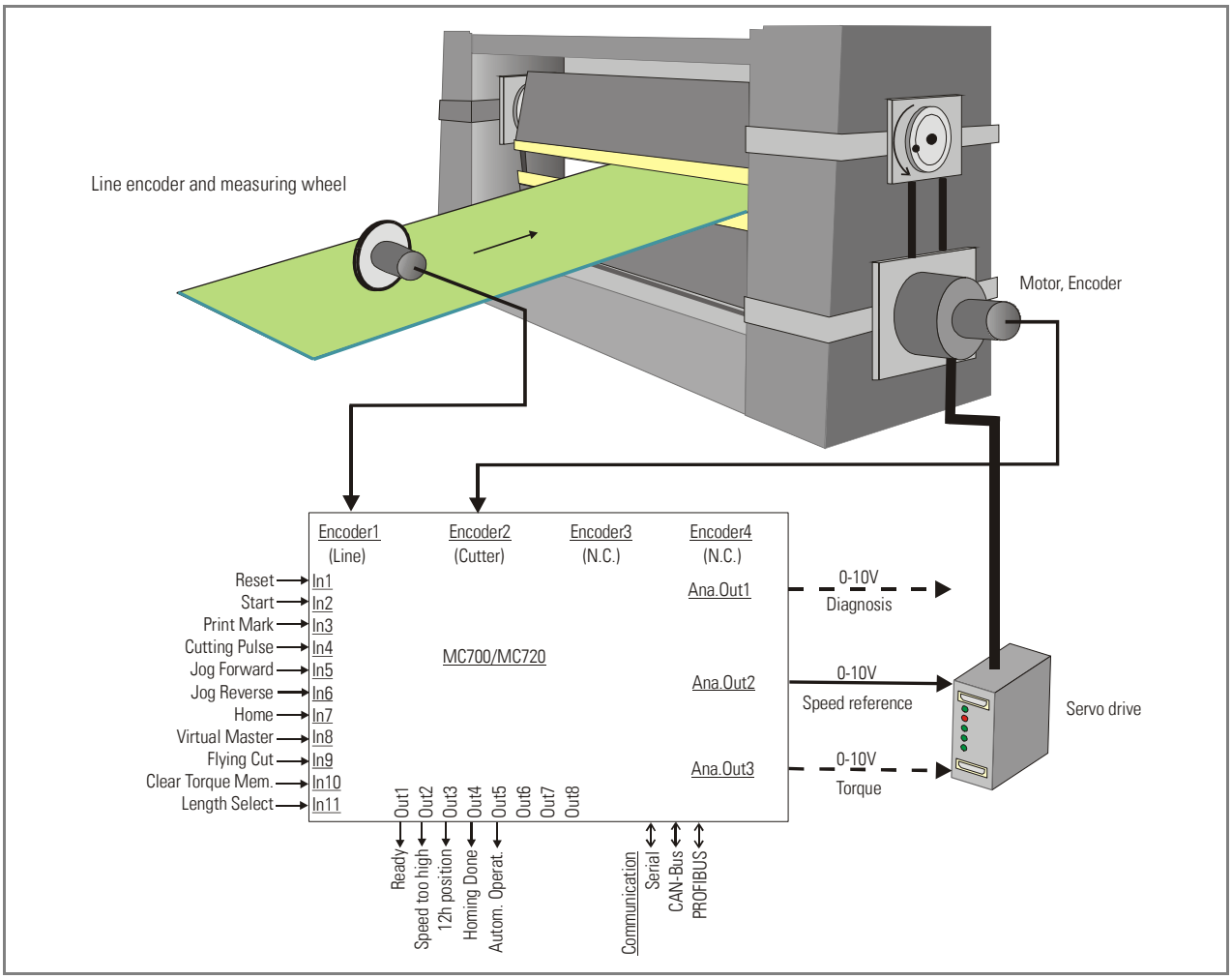


Moreover, on the Applications site of above homepage you can watch a short demo movie showing a typical application of the firmware described here.

Please note, the CT701 firmware is liable to payment of a license fee. The license key necessary for setup will be delivered upon remittance of the licence fee.

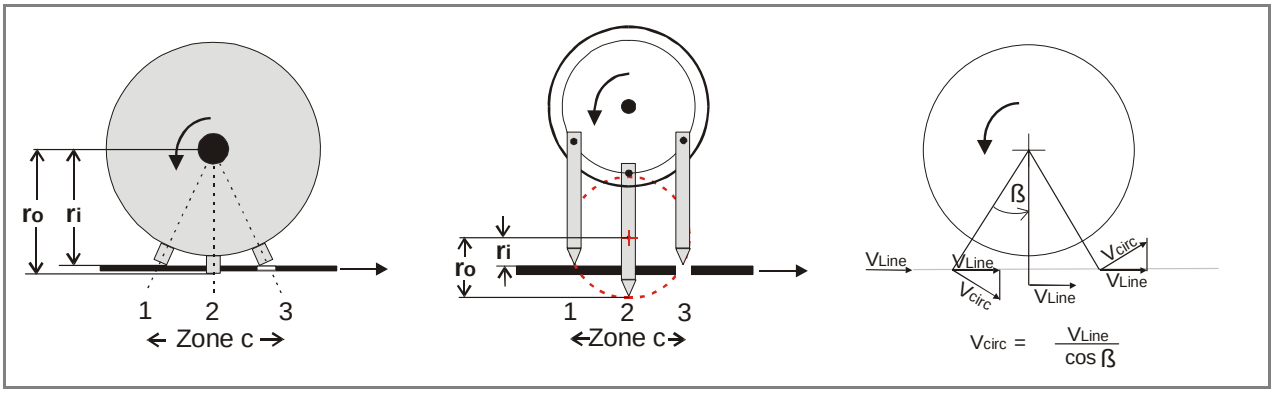
2. General remarks about functions of this firmware

This firmware is suitable, together with motrona controllers of type MC700 or MC720 and an appropriate servo drive, to generate and control an optimized speed profile for rotary guillotine cutting systems.



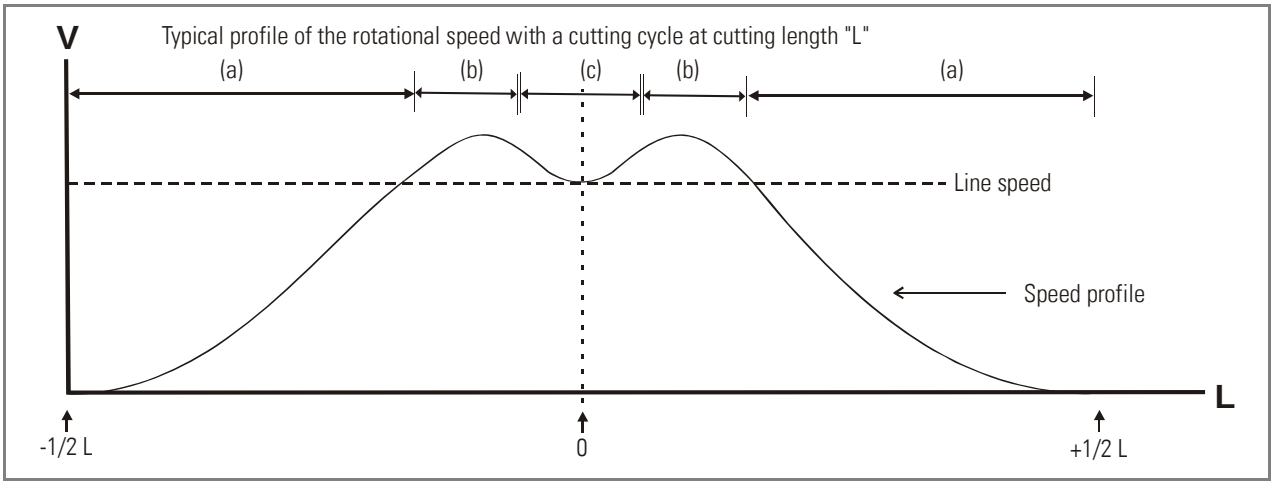
These cutting systems require the horizontal speed of the cutting tool to be synchronous to the material at any time of the penetration of the tool, whereas outside of the penetration zone, it is the cutting length and the active radius of the rotation that determine the speed profile.

The subsequent drawing explains the principle of a rotating puncher, the principle of a rotating shear, and also the geometric basis of the process. It is easy to understand that, during the penetration of the tool, both applications require an angular correction of the rotational speed, as soon as the difference between the inner radius ri and the outer radius ro is no more negligible.



Also it is required to have a smooth profile with no angles and edges, where all values of acceleration and deceleration are reduced to the possible physical minimum.

As a result of these requirements we find a speed profile as follows:



Zone (a) results from the ratio between the cutting length and the active rotating circumference of the tool.

Length > circumference reduces the speed of this zone (with respect to line speed) and may include temporary standstill.

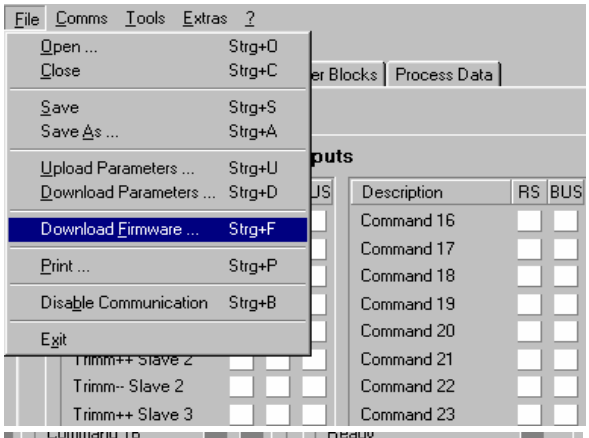
Length < circumference however increases the speed of this zone. Zone (b) is an over swing zone, necessary to allow an edge-free transition from zone (a) to zone (c).

Zone (c) is the penetration zone of the tool, and the shape of the profile is ruled by the geometry of the machine, requiring a reciprocal cosine curve in this situation.

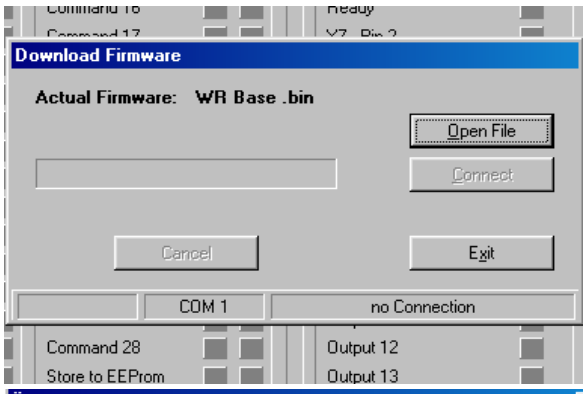
The CT701 firmware continuously calculates an optimized speed profile from the geometric properties of the machine with consideration of actual cutting length and momentary line speed.
Very short control loop cycles combined with the smart algorithms of profile calculation provide excellent accuracy, efficiency and performance.

3. Download Procedure

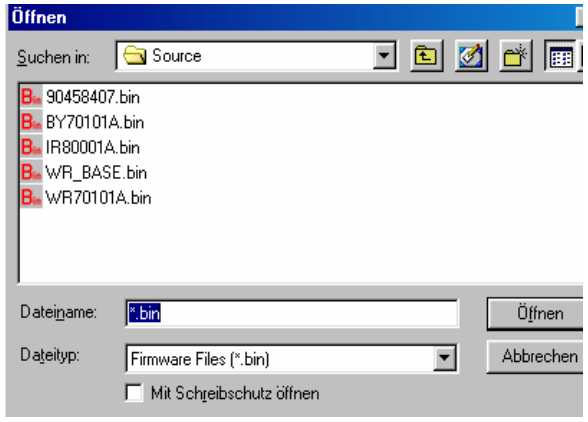
Ex factory, all MC 700- and MC 720 controllers have loaded the MCBase firmware, which was used for factory testing purposes.
To download an application firmware, please take the following steps:



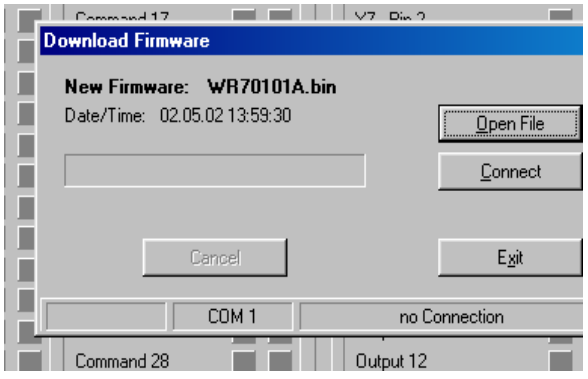
- Connect the PC to the controller, using a RS232 cable (see 3.8 of the hardware manual). Apply power to the controller and start the OS5.1 PC software. Select "Download Firmware" from the "File" menu.



- The screen now indicates the firmware which is actually loaded to the unit, in general "MCBaseXX.bin"

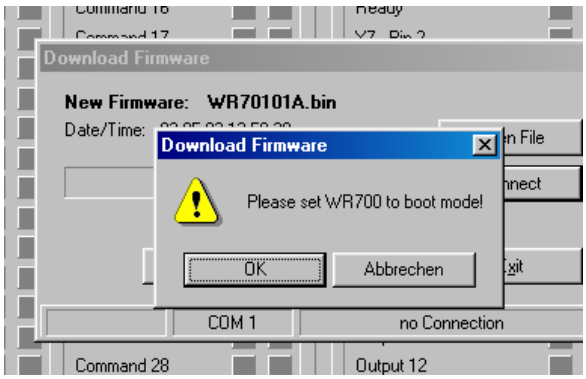


- Click to "Open File" and select drive and file name of the download firmware (BY701xxx.bin).



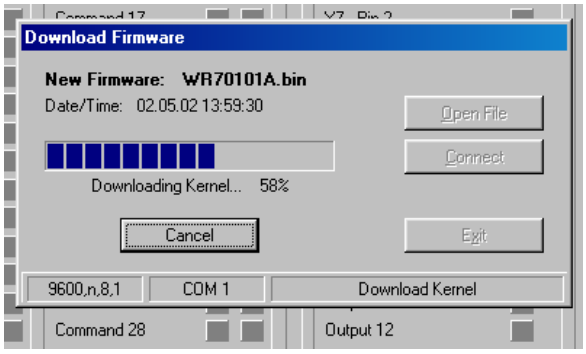
- Then click to "Connect".

(Pictures beside use screenshots of firmware WR70101a.bin)

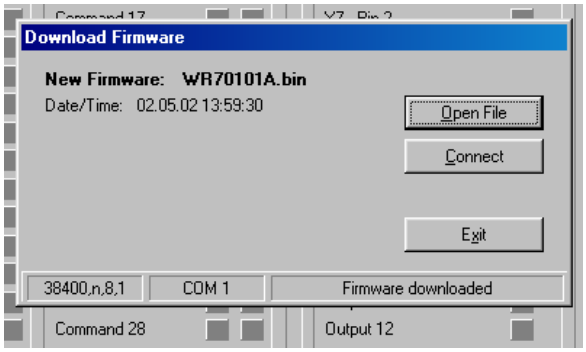


- The PC now requests you to set the controller to the "boot mode". To do this, slide the front switch from the "Run" position to the "Program" position and push the Reset button located behind the front plate, by means of a pen or a small screw driver

- Click „OK" to start the download

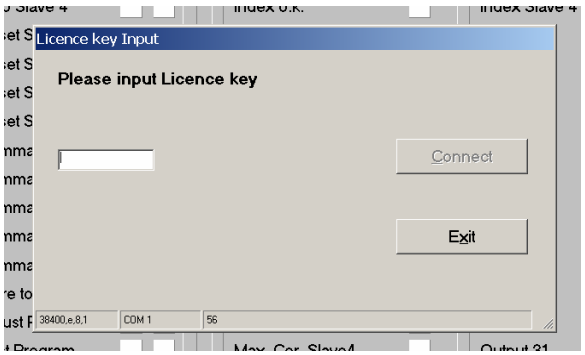


- The download uses several loading steps. The progress is displayed on the screen.



- <u>After successful conclusion of the procedure</u>

a. click to "Exit"
b. slide the switch back to the "Run" position
c. activate the Reset button for new initialization of the controller

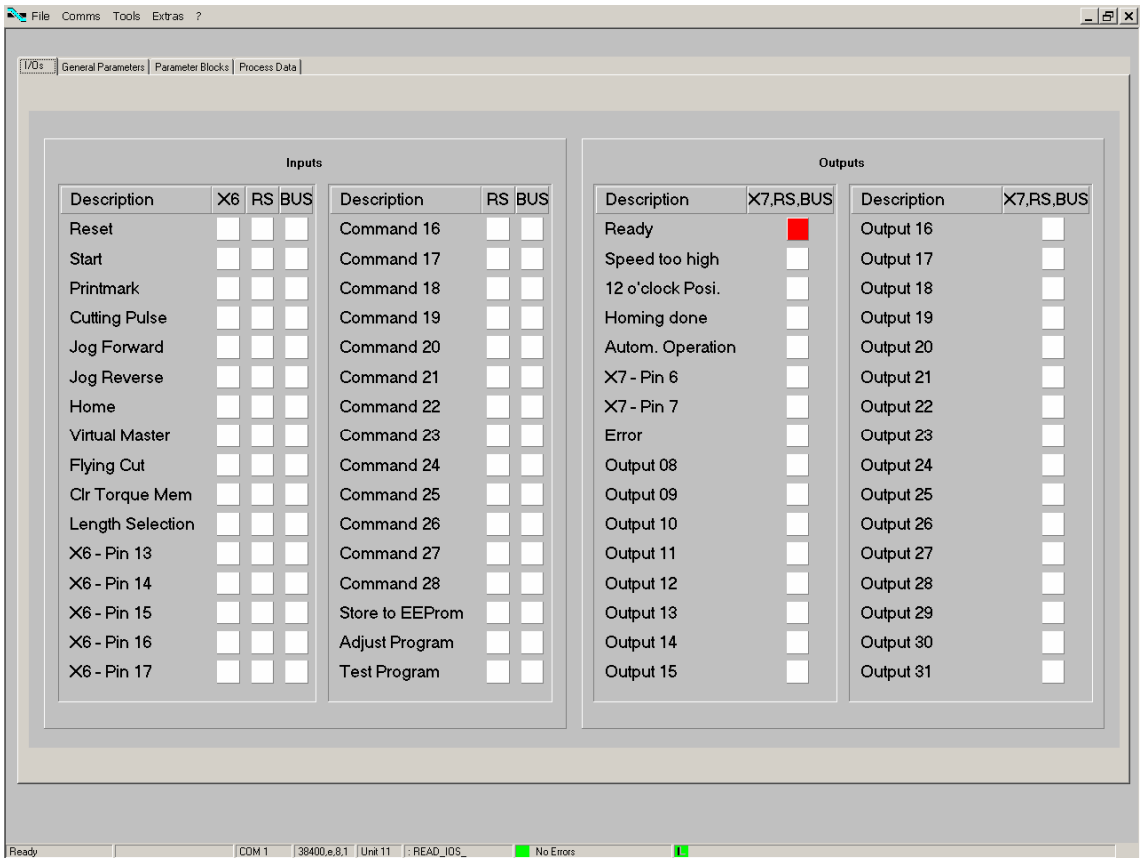


- Finally you must input the <u>license key</u>:

a. Select "Input license key"" from the "File" menu
b: Input the license key and click to "connect"

4. How to use the operator software

The OS5 software uses a clear structure of register cards and the contents automatically adapt to the firmware of the controller.



4.1. I/Os (Inputs and Outputs)

This register card shows the logical state of all digital inputs and outputs.

4.1.1. Inputs

Inputs which are in use for the current application are marked with text, and unused inputs are marked with “Command …” only.
Indicator boxes in the column marked “X6” shine blue, when the associated input signal on screw terminal strip X6 is HIGH. LOW state is white.

Indicator boxes in the columns marked “RS” shine blue when the associated input signal has been switched on via serial link. White box means “signal off”. You can switch on and off every input from your PC by clicking to the corresponding indicator box in the “RS” column.

Indicator boxes in the column “BUS” shine blue, when the associated input signal has been switched on via CANBUS. White box means again “signal off”. All input signals follow a logical “OR” conjunction and the input is in “ON” state when one or several boxes shine blue.

On the connector plate of the MC700 hardware, the inputs are accessible via terminals “In1” to “In16” and the sequence from up to down corresponds to the same layout as visible on the PC screen.

Meaning and function of the input signals:

⌐ = static operation
↑ = dynamic operation, rising edge
Ser/Bus = Activation by serial command or by field bus only.

In01 ⌐	Reset	Resets all functions and counters
In02 ⌐	Start	LOW = automatic operation OFF HIGH = automatic operation ON
In03 ↑	Print mark	Prepared for connection of a print mark sensor. Actually not used yet
In04 ↑	Cutting pulse	Sensor input for HTL cutting pulse. For definition of the knife position, the controller needs one index pulse with every cut, which can be generated either by a remote sensor or from the marker pulse of the encoder. (See register “Index Mode”)
In05 ⌐	Jog forward	Moves the cutter drive forward (manual operation)
In06 ⌐	Jog reverse	Moves the cutter drive reverse (manual operation)
In07 ↑	Home	Starts a homing cycle and sets the knife to a defined home position
In08 ⌐	Virtual Master	Switches the „virtual master axis“ on, which allows to run the shear without material. The command must switch on while the Start input is LOW
In09 ↑	Flying cut	Starts an immediate „flying cut“
In10 ⌐	Clear Torque Memory	Clears the record register for the torque
In11 ⌐	Length Selection	Selects one of the two preset cutting lengths: LOW = Length1 HIGH = Length2
In12 … In16	X6 – Pin 13 … X6 – Pin 17	Not in use

Ser Bus	Command 16 … Command 28	Not in use
Ser Bus	Store to EEPROM	Stores all actual parameters and variables to the EEPROM
Ser Bus	Adjust Program	Starts the Adjust program for testing and commissioning (Will be set automatically by PC operator software when you select "Adjust…" in menu "Tools")
Ser Bus	Test Program	Starts the Test program for testing and commissioning (Will be set automatically by PC operator software when you select "Test…" in menu "Tools")

4.1.2. Outputs

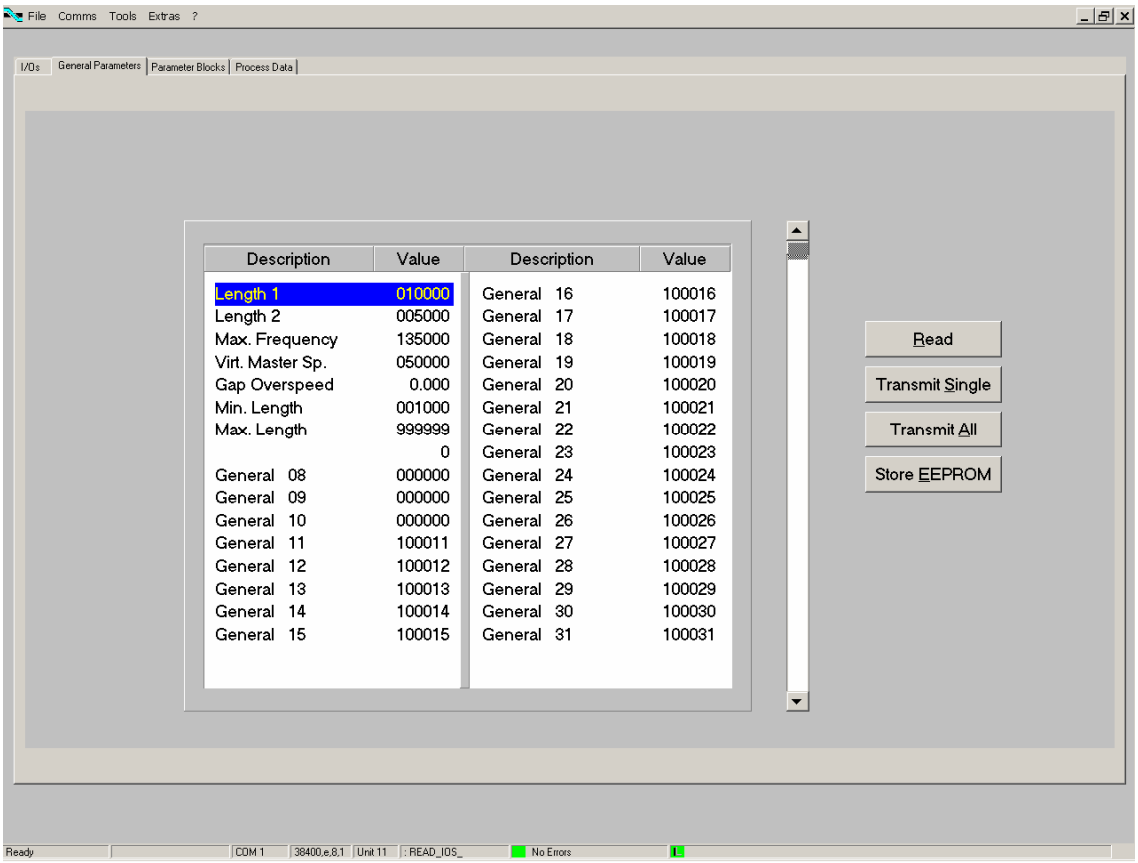
Outputs which are in use for the current application are marked with a text, and unused outputs are marked with "output …" only.
The indicator box shines red when the corresponding output is HIGH, otherwise the box remains white. Outputs on the screen appear in the sequence of their mechanical layout on the connector panel

Meaning and function of the output signals:

Out1	Ready	Indicates that the unit is ready to work after power-up, initialisation and self-test. This output, however, is not a guarantee for trouble-free operation of all functions.
Out2	Speed too high	Goes HIGH when the analogue speed output command exceeds the preset maximum output value
Out3	12 h position	Generates a pulse with adjustable duration every time the shear position passes "12 o'clock" position (opposite of the cutting position)
Out4	Homing Done	Set to on when the homing cycle is finished. Reset to off when the home position is no more valid and a new homing cycle should be executed (after Reset, Jog, power down etc.).
Out5	Automatic Operation	Set to on during automatic cutting operation when input "Start" is on. When input "Start" is reset to off, this output is set to off not before the actual cut is finished and the cutting roll is at standstill.
Out6	X7 – Pin6	Not in use
Out7	X7 – Pin7	Not in use
Out8	Error	An error has occured.

4.2. General Parameters

This register card holds the essential variable settings of general nature



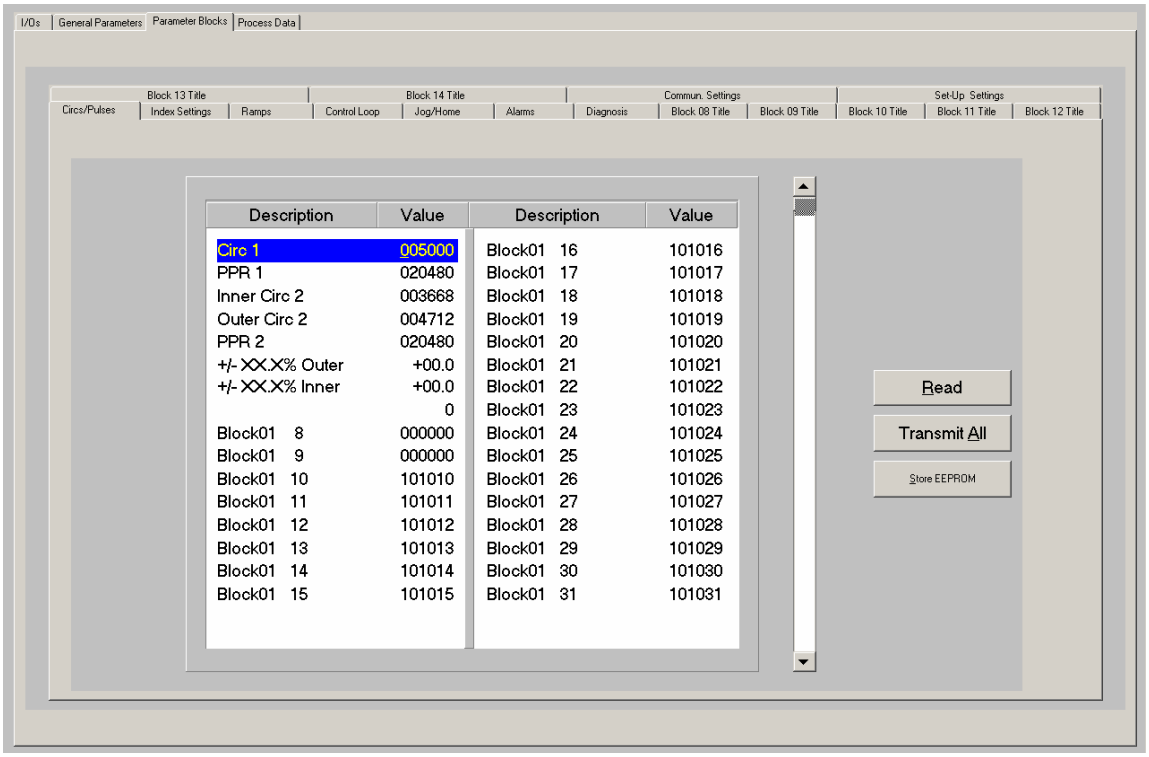
Length1	Preset of the desired cutting length 1 scaled in length units according to user definition (active with input “Length Selection” = LOW)
Length2	Preset of the desired cutting length 2 scaled in length units according to user definition (active with input “Length Selection” = HIGH)
Max Frequency	Expected maximum frequency of the master encoder (Hz). Used for pre-scaling of the analogue output.
Virtual Master Speed	Preset speed of the virtual master axis (Hz)
Gap Overspeed	Temporary overspeed after the cut to create a gap (Added supplementary speed = Actual line speed x register setting)
Min. Length	Lower limit for length preset values (Length units)
Max. Length	Upper limit for length preset values (Length units)

4.3. Parameter Blocks

This field contains more parameters and machine specifications, separated to clearly arranged blocks.

4.3.1. Circs/ Pulses

This block defines the mechanical dimensions and associated ppr numbers of the encoders.



Circ1	Circumference of the measuring wheel or the feed roll of the material line (Master) Scaling: Length units
PPR1	Number of incremental encoder pulses with one revolution of the measuring wheel, with consideration of the selected quadrature edge count (x1, x2, x4)
Inner Circ2	Inner active circumference of the rotating knife in length units (= 2 π x ri , see section 2.)
Outer Circ2	Outer active circumference of the rotating knife in length units (= 2 π x ro , see section 2.)
PPR2	Number of incremental encoder pulses with one revolution of the rotating cutter roll, with consideration of the selected quadrature edge count (x1, x2, x4)
+/-xx.x% Outer	Fine tuning of the profile shape during penetration of the tool, referring to the radius of the outer circle ro. Normal setting 00.0
+/-xx.x% Inner	Fine tuning of the profile shape during penetration of the tool, referring to the radius of the inner circle ri. Normal setting 00.0

4.3.2. Index Settings:

This register card defines origin and evaluation of the index signals

<table>
<tr><td>Mode</td><td colspan="3">Currently not used, reserved for future use.</td></tr>
<tr><td>Index Mode</td><td colspan="3">The cutting pulse necessary with every cut (mandatory) and a print mark or index pulse from the line (optional) can be applied as a HTL/24V signal to the digital inputs, or as a TTL/RS422 signal to the SUB-D-connector of the corresponding encoder input:</td></tr>
<tr><td></td><td>Ind. Mode:</td><td>Cutting pulse source:</td><td>Master index source:</td></tr>
<tr><td></td><td>0</td><td>HTL (Cont.In04, X6 terminal 5)</td><td>HTL (Cont.In03, X6 terminal 4)</td></tr>
<tr><td></td><td>1</td><td>TTL/RS422 (Encoder2, Pin 6/7)</td><td>HTL (Cont.In03, X6 terminal 4)</td></tr>
<tr><td></td><td>2</td><td>HTL (Cont.In04, X6 terminal 5)</td><td>TTL/RS422 (Encoder1, Pin 6/7)</td></tr>
<tr><td></td><td>3</td><td>TTL/RS422 (Encoder2, Pin 6/7)</td><td>TTL/RS422 (Encoder1, Pin 6/7)</td></tr>
<tr><td>Slave Index Div.</td><td colspan="3">Impulse divider for cutting pulse. Setting to a value n > 1 evaluates only every nth cutting pulse</td></tr>
<tr><td>Slave Z Offset</td><td colspan="3">Offset register for virtual displacement of the physical cutting impulse (generated from encoder index or by proximity). Setting in +/- encoder increments. This register makes superfluous a precise mechanical adjustment of the location of the pulse (the virtual cutting pulse must be located exactly in the peak position of tool penetration)</td></tr>
<tr><td>Time Pulse out</td><td colspan="3">Sets the pulse duration of the 12 o'clock pulse output (x.xxx sec) which the unit generates exactly in the opposite position of the virtual cutting pulse.</td></tr>
</table>

4.3.3. Ramps

This register card is designed for future functions and remains currently unused.

4.3.4. Control Loop

Defines the properties of the closed loop position control:

Gain-Correction	Sets the proportional Gain of the position control loop in relation to positional errors
Sampling Time	Sampling time of the Master frequency input. Used to smoothen the analogue output with unsteady input frequencies
Gain Torque	Proportional Gain of the torque analogue output. The torque output voltage is proportional to the differential error during the cut. When the next cut begins, the torque output starts with the value that has been stored after the previous cut. When an error higher than the previous error is detected, the new value will overwrite the previous value.

4.3.5. Jog/Home

This register card specifies the Jog and Homing functions:

Jog Speed	Jog speed for manual movement of the cutter drive
Jog Ramp	Ramp time for acceleration and deceleration when using the Jog function
Home Speed Hi	Fast Homing speed. Every homing cycle will start with this speed.
Home Speed Lo	Slow Homing speed. A Homing cycle will end with this speed
Home Ramp	Ramp time for acceleration and deceleration with Homing cycles
Home Switchpnt	Distance from the final home position (scaled in length units) where the homing speed changes over from high speed to low speed.

4.3.6. Alarms

Settings for monitoring functions:

Min. Master Frequency	When the real master encoder frequency becomes lower than this set value, the unit substitutes the encoder frequency by this setting. This prevents the shear from stopping while the tool is penetrated to the material.
Max. Analogue Output	When the analogue speed output signal gets higher than this setting, the "Speed too High" output signal will switch on.

4.3.7. Diagnosis

Settings for diagnosis functions:

Sel. Diag. Ana Out 1	Selects the actual value (Process Data) that is put out at analogue output "Ana Out 1". The gain of the analogue diagnosis signal is set by parameter "Ana Out 1 Gain". When set to 10.00, an actual value of 2048 is repre-sented by an analogue output voltage of 10 V.

4.3.8. Communication settings

This register card sets the communication parameters for the CAN interface and the serial link.

Settings and operation of the CANopen interface are explained separately in the manual CI700, which is available on our homepage or on our CD-ROM

The serial link uses the following parameters:

<table>
<tr><td>Ser. Unit Address</td><td colspan="4">Serial unit address. Range 11 ... 99.
Address numbers containing zeros like 01, 02, 03, ..., 10, 20, etc. are not permitted because these are reserved for broadcast messages (collective addressing of several units)
Factory default address is always 11.</td></tr>
<tr><td>Ser. Baud Rate</td><td colspan="4">0: 38400 bps
1: 19200 bps
2: 9600 bps
3: 4800 bps
4: 2400 bps
Factory setting: 2</td></tr>
<tr><td rowspan="12">Ser. Data Format</td><td>Setting</td><td>Data bits</td><td>Parity</td><td>Stop bits</td></tr>
<tr><td>0</td><td>7</td><td>even</td><td>1</td></tr>
<tr><td>1</td><td>7</td><td>even</td><td>2</td></tr>
<tr><td>2</td><td>7</td><td>odd</td><td>1</td></tr>
<tr><td>3</td><td>7</td><td>odd</td><td>2</td></tr>
<tr><td>4</td><td>7</td><td>none</td><td>1</td></tr>
<tr><td>5</td><td>7</td><td>none</td><td>2</td></tr>
<tr><td>6</td><td>8</td><td>even</td><td>1</td></tr>
<tr><td>7</td><td>8</td><td>odd</td><td>1</td></tr>
<tr><td>8</td><td>8</td><td>none</td><td>1</td></tr>
<tr><td>9</td><td>8</td><td>none</td><td>2</td></tr>
<tr><td colspan="4">Factory setting: 0</td></tr>
</table>

4.3.9. Setup Settings:

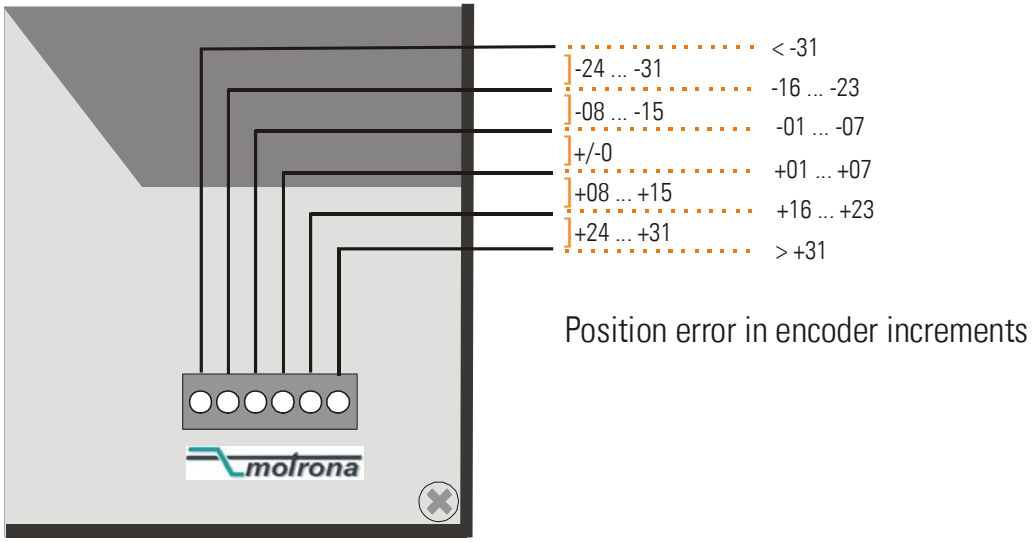
These settings define all important hardware properties of inputs and outputs of the MC700 controller.
You must only make settings for these functions that are really used and wired with this application (see 2.).

Mode Counter (1–4)	Determines the number of edges counted from the four incremental encoder inputs: 0 = (x1), 1 = (x2) 2 = (x4)
Dir. Counter (1–4)	Assigns a counting direction (up / down) to the corresponding encoder input, depending on the quadrature A/B phase displacement. These parameters are found out and set best in the Test menu or the Adjust menu
Ana-Out Offset (1–4)	Sets the zero position of the corresponding analogue output. This parameter uses a numeric range from –2047 ... 0000 ... +2047 corresponding to --100% ... 0000 ... +100% full scale output
Ana-Out Gain (1-4)	Sets the full scale output of the corresponding analogue output, directly in volts. 0 – 10,00 means 0 – 10 volts or 20 mA
Ana-In Offset (1-4)	Sets the zero position of the corresponding analogue input. This parameter uses a numeric range from –2047 ... 0000 ... +2047 corresponding to --100% ... 0000 ... +100% full scale input.
Ana-In Gain (1-4)	These parameters remain unused with the application of this firmware..
Index output	
Frequency Output	
Dir. Frequency	
Frequency Select	
Index 1 select	
Index 2 select	
Index 3 select	
Index 4 select	

5. Function of the LED indicators

There are 6 red LEDs mounted to the connector plate of the unit, for display of the actual positional error of the tool position with regard to the scheduled position. The LEDs are scaled in encoder increments and the update cycle is less than one millisecond. Therefore, this simple means of error display provides a good information about the dynamic performance of the control loop.

With hardware version MC720, also the front LEDs operate in a similar way.

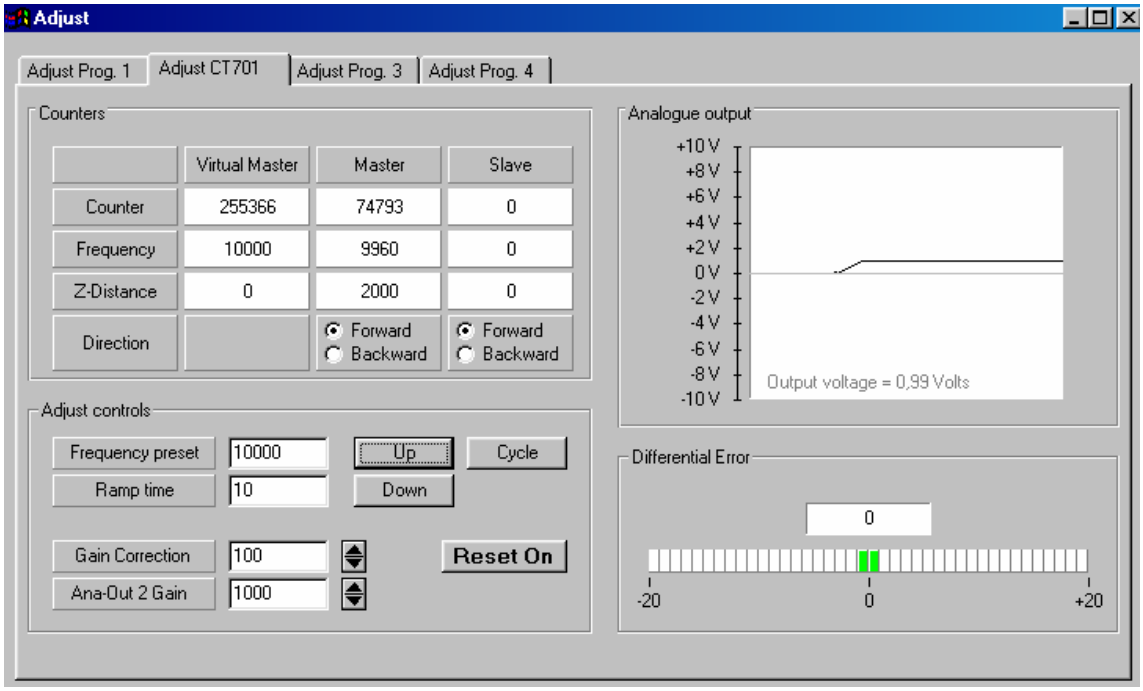


6. Steps for Commissioning

For setup and commissioning of all drives, the “Adjust” menu is available under “Tools” in the main menu of the screen.

At this time, all drives must be adjusted to a proper and stable operation over the full speed range. Slave drives need a maximum of dynamics and response (set ramps to zero, switch of any integral or differential component of the internal speed control loop, operate the drive with proportional speed control only, with the proportional Gain as high as possible).

Before you start the Adjust menu, make sure that all parameters on the required register cards are set correctly. Where you find the possibility for integration, please switch it off for the first steps (set “Int.Time” to 000)



The Adjust Program is used to set the directions of rotation of the encoders and to adjust the analogue output with regard to the output level and the proportional Gain.

For the adjustment procedure, the Slaves uses always the virtual master axis as a reference

6.1. Preparations

Before starting the procedure, the following settings should be done:

- Frequency Preset:
  Set the virtual line speed that you would like to use for adjusting. This setting is directly in Hz of Master encoder frequency and the default value is 10% of the maximum frequency you have set before (= recommended speed for adjustments).

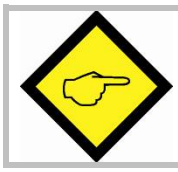
- Ramp Time:
  This ramp time is used for all acceleration and deceleration during the adjust procedure.

- Gain-Correction:
  An initial setting of 500 is recommended.

- Ana-Out-Gain:
  Start with the default value of 1000 which corresponds to a maximum analogue output of 10.00 volts.

6.2. Directions of Rotation

- Move your Master encoder into forward direction (manually or by means of a remote speed signal)
- Observe the counter in the Master column. It must count up (increment)! Where you find it counts down, please click to the unchecked direction box of the master column (Forward or Reverse) to change the direction.
- When the master counter counts up while the master moves forward, the definition of the Master direction is o.k.
- Click to the "Up" key to start the slave drive.
- It is a must that the Counter in the "Slave" column counts up (increments).
- Where you find it counts down, please click to the other direction box (Forward or Reverse) to force it to upwards count.
- Once it counts up, click to the "Down" key to stop the drive again. The definition of direction of rotation has been stored to the unit now



Only when both counters counts up while the according axis moves forward, the definition of the Encoder direction is correct!

6.3. Tuning the analogue output

- Start the drive again by clicking "Up". Now switch the Reset to OFF by clicking to the Reset key showing actually "Reset On". This activates the closed loop control.
- Observe the colour bar and the differential counter in the field "Differential Error".
  There are two possibilities:

  a. The bar graph moves to the right and the counter counts up (+):
     The analogue output then is too low. Please increase the setting of "Ana-Out Gain" by overtyping the figures or by scrolling up with the arrow key.

  b. The bar graph moves to the left and the counter counts down (-):
     The analogue output then is too high. Please decrease the setting of "Ana-Out Gain" by overtyping the figures or by scrolling down with the arrow key.

"Ana-Out Gain" is set correctly when the bar graph remains in it's green/yellow centre position and the differential counter swings around zero (i.e. +/-8)

You can reset the differential counter to zero at any time between, by cycling the "Reset" command.

6.4. Setting of the proportional Gain

The setting of register "Gain-Correction" determines how strong the controller responds to position and speed errors of the drive. In principle, the setting therefore should be as high as possible. However, depending on dynamics and inertia of the whole system, too high gain values can produce stability problems.

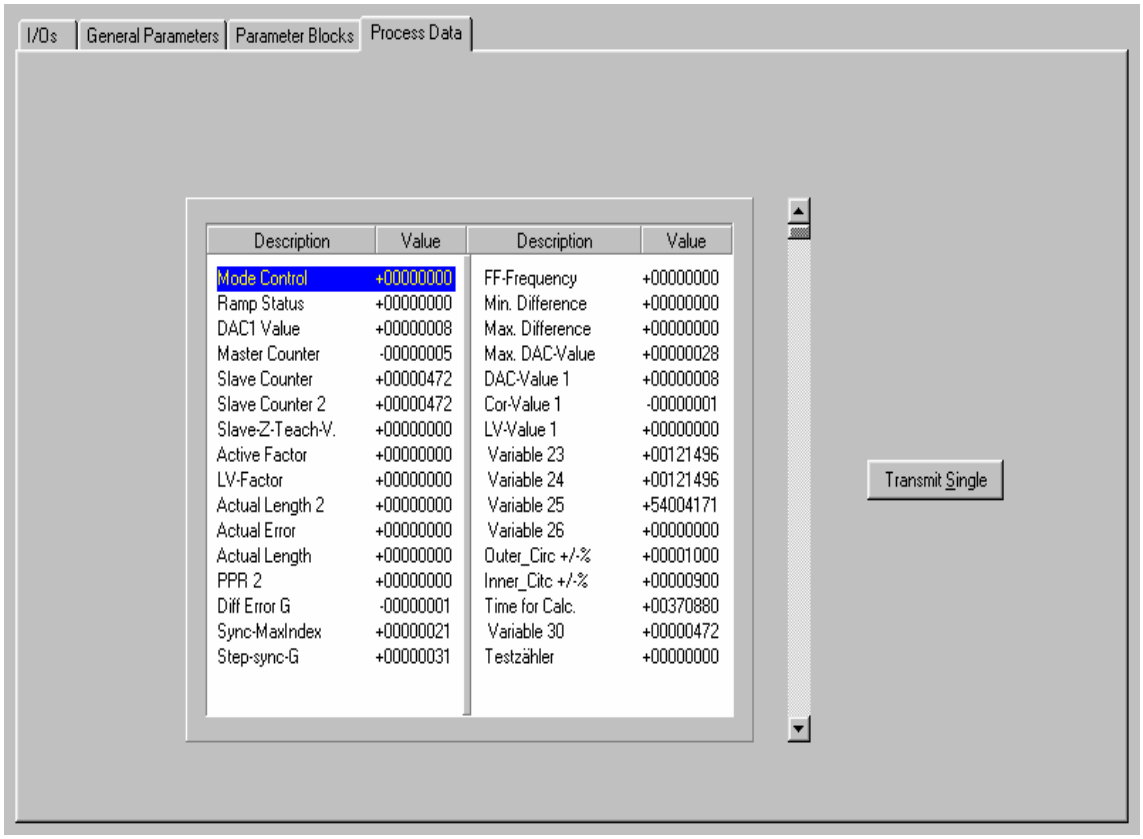
Please try to increase the setting from 500 to 1000, 1500, 2000 etc. As soon as you find unsteady operation, noise or oscillation, you must reduce the setting again correspondingly.

We also recommend using the automatic "Cycle" function for observations with stability. When clicking to this key, the drive will continuously ramp up and down while you can observe the colour bar and the differential counter.

Once you have done these steps, you can leave the Adjust menu and your machine is ready for operation.

7. Process data (actual values)

You can follow all real process data assigned to this firmware, when you open the register card “Process data”. These actual values are updated continuously.



You find a description of the actual process data values in the corresponding table of chapter 9.

8. Hints for controller type MC720 with integrated operator terminal

Controllers type MC720 are equipped with a keypad and a LCD display, providing all entries and operations of the controller.

Please note that this solution does not support change of parameters "on the Fly", but only in standstill.
Also this type is not suitable to replace a PC during commissioning.

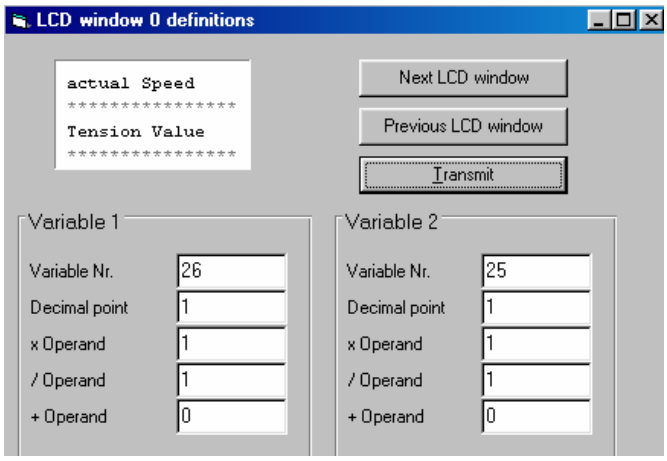
8.1. Setting of parameters and registers

All the menu structure of the LCD display is fully similar to the structure of the register cards with the PC software. To start the menu, press F1. Select the menus and sub-menus by using the arrow keys ↓ nd ↑ .Confirm your choice by Enter. With all further actions, Enter will go forward and PRG go back in the menu structure.
For all operations, just follow the hints given on the LCD menu.

Once you have studied section 4 of this manual, all keypad and LCD operations will be self-explaining.

8.2. Display of actual process values

During normal production, you can use the LCD for display of interesting actual values and process data. The PC operator software allows you to define and to scale these values and to add text comments according to your choice.
The menu "LCD Definitions" can be found under "Extras" of the head line menu.



- There are totally 4 LCD windows accessible (0 – 3) and the actual window number appears in the blue head line. To change from one window to another, use the keys "Next LCD window" or "Previous LCD window".

- Each window allows displaying two actual values with two text comments. The line with asterisks ******* serves as space holder for the values displayed later on the LCD. When you click to the text line, you can edit the text comments according to your need (max. 16 characters for each text comment)

- Variable Nr: Defines which of all available values should appear in the display. Please choose one of the 32 available actual values (00 – 31) as shown on the screenshot "Process Data"

- Decimal point: Defines the position where a decimal point should appear on the LCD display (0=no decimal point)

- xOperand, /Operand, +Operand: These 5 decade operands can be used to change the scaling of your display value to the desired engineering units.

When you have entered your specifications to a window, click to "Transmit" to store your definitions to the controller.

In production state, you can use the key F2 to switch from one of the four windows to the next and to read the actual values you have assigned.

Key F1:	Enter into the menu for setting or modifying parameter
Key F2:	Cycle from one window to next to read actual process values

9. Parameter Tables

General Parameters

Description	Unit	Serial Code		Minimum	Maximum	Default
		(Hex)	(Dec)			
Length 1	Length units	0000	0	1	999999	1000
Length 2	Length units	0001	1	1	999999	1500
Max. Frequency	Hz	0002	2	1	500000	100000
Virt. Master Speed	Hz	0003	3	0	500000	10000
Gap Overspeed		0004	4	0	1000	0
Min. Length	Length units	0005	5	1	999999	500
Max. Length	Length units	0006	6	1	999999	10000
(General 07)		0007	7	0	0	0
…		…	…			
(General 31)		001F	31	0	0	0

Parameter Blocks:
Circs / Pulses

Description	Unit	Serial Code		Minimum	Maximum	Default
		(Hex)	(Dec)			
Circ 1	Length units	0100	256	1	999999	1000
PPR 1	Increments	0101	257	1	999999	10000
Inner Circ 2	Length units	0102	258	1	999999	900
Outer Circ 2	Length units	0103	259	1	999999	1000
PPR 2	Increments	0104	260	1	999999	10000
(Block01 8)		0105	261	0	0	0
…						
(Block01 31)		011F	287	0	0	0

Index Settings

Description	Unit	Serial Code		Minimum	Maximum	Default
		(Hex)	(Dec)			
Mode		0120	288	1	2	1
Index Mode		0121	289	0	3	0
Slave Index Div.		0122	290	1	99	1
Slave Z Offset	Increments	0123	291	-999999	999999	0
Time Pulse out	s	0124	292	0.001	9.999	0.100
(Block02 8)		0125	293	0	0	0
…						
(Block02 31)		013F	319	0	0	0

Ramps

Description	Unit	Serial Code		Minimum	Maximum	Default
		(Hex)	(Dec)			
Ramp	s	0140	320	0.1	10.0	1.0
(Block03 1)		0141	321	0	0	0
…						
(Block03 31)		015F	351	0	0	0

Control Loop

Description	Unit	Serial Code		Minimum	Maximum	Default
		(Hex)	(Dec)			
Gain Correction		0160	352	0	999.9	10.0
Sampling Time	ms	0161	353	1	999	1
Gain Torque		0162	354	0	9999	100
(Block04 3)		0163	355	0	0	0
…						
(Block04 31)		017F	383	0	0	0

Jog / Home

Description	Unit	Serial Code		Minimum	Maximum	Default
		(Hex)	(Dec)			
Jog Speed	V	0180	384	0	9.99	1.00
Jog Ramp	s	0181	385	0.20	999	1.00
Home Speed Hi	V	0182	386	0	99	1.00
Home Speed Lo	V	0183	387	0	99	0.50
Home Ramp	s	0184	388	1	99	1
Speed Switchpoint	Length units	0185	389	0	999999	1000
(Block05 6)		0186	390	0	0	0
…						
(Block05 31)		019F	415	0	0	0

Alarms

Description	Unit	Serial Code		Minimum	Maximum	Default
		(Hex)	(Dec)			
Min. Master Freq.	Hz	01A0	416	0	999999	100
Max. Anal. Outp.	V	01A1	417	0.00	9.99	9.50
(Block06 2)		01A2	418	0	0	0
…						
(Block06 31)		01BF	447	0	0	0

Diagnosis

Description	Unit	Serial Code		Minimum	Maximum	Default
		(Hex)	(Dec)			
Sel.Diag.AnaOut1		01C0	448	0	31	0
(Block06 2)		01C1	449	0	0	0
…						
(Block06 31)		01DF	479	0	0	0

Communication Settings

Description	Unit	Serial Code		Minimum	Maximum	Default
		(Hex)	(Dec)			
Can Unit Address		02C0	704	001	127	001
Can Baud Rate		02C1	705	0	7	1
Can Config.		02C2	706	000	255	000
Can Tx Par		02C3	707	000	255	000
Can Rx Par		02C4	708	000	255	000
Ser Unit Address		02C5	709	11	99	11
Ser Baud Rate		02C6	710	0	4	2
Ser Data Format		02C7	711	0	9	0
(Block 15 8)		02C8	712			
…		…	…			
(Block 15 31)		02DF	735			

Setup-Up Settings

Description	Unit	Serial Code		Minimum	Maximum	Default
		(Hex)	(Dec)			
Mode Counter 1		02E0	736	0	2	0
Dir. Counter 1		02E1	737	0	1	1
Mode Counter 2		02E2	738	0	2	0
Dir. Counter 2		02E3	739	0	1	1
…		…	…			
Ana-Out Offset 1		02E8	744	-2047	+2047	0
Ana-Out Gain 1		02E9	745	000.00	320.00	1000
Ana-Out Offset 2		02EA	746	-2047	+2047	0
Ana-Out Gain 2		02EB	747	000.00	320.00	1000
Ana-Out Offset 3		02EC	748	-2047	+2047	0
Ana-Out Gain 3		02ED	749	000.00	320.00	1000
Ana-Out Offset 4		02EE	750	-2047	+2047	0
Ana-Out Gain 4		02EF	751	000.00	320.00	1000
…		…	…			
Index 4 select		02FF	767	0	2	0

Process Data (Aktuelle Istwerte)

Nr.	Description	Unit	Serial Code		Explanation
			(Hex)	(Dec)	
0	Mode Control		0800	2048	Internal program status
1	Ramp Status		0801	2049	Internal status value
2	DAC1 Value	5 mV	0802	2050	Digital output voltage value (scaled in DAC-increments: -2000 = -10V, +2000 = +10V)
3	Master Counter	Ma.Inkr.	0803	2051	Counter for master pulses
4	Slave Counter	Sl. Inkr.	0804	2052	Counter for slave pulses
5	Slave Counter 2	Sl. Inkr.	0805	2053	
6	Slave-Z-Teach-Value	Sl. Inkr.	0806	2054	Set value for slave counter at cutting pulse
7	Active Factor		0807	2055	Actual encoder pulse ratio
8	Slave Z Offset	Sl. Inkr.	0808	2056	Offset between real and virtual cutting pulse
9	Actual Length 2	Ma.Inkr.	0809	2057	
10	Actual Error	Ma.Inkr.	080A	2058	Actual cutting error (scaled in master encoder pulses)
11	Actual Length	Ma.Inkr.	080B	2059	Actual cutting length (scaled in master encoder pulses)
12	PPR 2	Sl. Inkr.	080C	2060	Measured value of slave pulses per revolution
13	Diff Error G		080D	2061	Differential counter (Slave position error)
14	Sync-Max-Index		080E	2062	
15	Step-Sync-G		080F	2063	
16	FF-Frequency	Hz	0810	2064	Master encoder frequency (Hz)
17	Min. Difference		0811	2065	Min. Differential Error during cut
18	Max. Difference		0812	2066	Max. Differential Error during cut
19	Max. DAC-Value		0813	2067	Max. analogue output 2 value during cut
20	DAC-Value 1	5 mV	0814	2068	Similar to No. 2
21	Cor-Value 1		0815	2069	Correction value
22	LV-Value 1		0816	2070	Feed forward value
23	Variable 23		0817	2071	
24	Variable 24		0818	2072	
25	Variable 25		0819	2073	
26	Virtual Axis on		081A	2074	State of virtual master
27	Outer_Circ +/-%	Läng.einh.	081B	2075	Scaled „Outer Circ."
28	Inner_Circ +/-%	Läng.einh.	081C	2076	Scaled „Inner Circ."
29	Time for Calc	µs	081D	2077	Time for pre-calculations
30	Variable 30		081E	2078	
31	Variable 31		081F	2079	

Inputs (Commands)

Description	Ser. Code for single command		Bit No. in "Serial Commands" (0B01)	Hardware-Input X6 "Cont.In"	Explanation → see chapter 4.1
	(Hex)	(Dec)			
Reset	0900	2304	0	In 1	
Start	0901	2305	1	In 2	
Printmark	0902	2306	2	In 3	
Cutting Pulse	0903	2307	3	In 4	
Jog Forward	0904	2308	4	In 5	
Jog Reverse	0905	2309	5	In 6	
Home	0906	2310	6	In 7	
Virtual Master	0907	2311	7	In 8	
Flying Cut	0908	2312	8	In 9	
Clr Torque Mem	0909	2313	9	In 10	
Length Selection	090A	2314	10	In 11	
Command 11	090B	2315	11	In 12	
…	…	…	…		
Command 28	091C	2332	28	–	
Store to EEProm	091D	2333	29	–	
Adjust Program	091E	2334	30	–	
Test Program	091F	2335	31	–	

Outputs

Description	Ser. Code for single command		Bit No. in "Output Status" (0B04)	Hardware-Output X7 "Cont.Out"	Explanation → see chapter 4.1
	(Hex)	(Dec)			
Ready	0A00	2560	0	1	
Speed too high	0A01	2561	1	2	
12 o'clock position	0A02	2562	2	3	
Homing Done	0A03	2563	3	4	
Automatic Operation	0A04	2564	4	5	
(X7 – Pin 6)	0A05	2565	5	6	
(X7 – Pin 7)	0A06	2566	6	7	
Error	0A07	2567	7	8	
Output 08	0A08	2568	8	–	
…	…	…	…		
Output 31	0A1F	2591	31	–	

State of inputs and outputs

Description	Seral Code		Explanation → Bit-No. see tables above
	(Hex)	(Dec)	
Hardware Commands ("Cont.In" X6)	0B00	2816	
Serial Commands	0B01	2817	
CAN Commands	0B02	2818	
All Commands	0B03	2819	
Output Status	0B04	2820	